

# Facial Skin Complaints and Work at Visual Display Units

*A Histopathological Study*

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Facial punch biopsies from 83 patients with skin complaints with or without skin lesions and supposedly associated with work at visual display units (VDUs) were compared to biopsies from 51 subjects with no VDU exposure with or without skin lesions. Coded slides were assessed by three independent observers regarding hyperplasia of sebaceous glands, occurrence of telangiectases, intensity of inflammatory infiltrate, degree of hydropic degeneration of basal cells, occurrence of demodex folliculorum, number of mast cells and degree of degenerative changes in elastic fibers. No parameter was significantly more common in exposed subjects than in non-exposed persons with equivalent skin signs. The controls without skin lesions also showed various degrees of histologic changes. Hyperplasia of sebaceous glands was more common in men and in young persons. Degenerative changes in elastic fibers increased with age, but were also obvious in some persons under 35 years of age. In this study no characteristic histologic changes in facial skin were found in individuals with skin symptoms claimed to be associated with exposure to VDUs.

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Skin complaints in persons exposed to visual display units (VDUs) have been reported from Norway (1), the United Kingdom (2), the United States (3) and Sweden (4, 5). Most of these patients have had rosacea or rosacea-like dermatitis. There have also been a few epidemiological studies of these problems (6-8). In an epidemiologic study comparing persons with and without VDU exposure (8), the exposed persons had significantly more subjective skin complaints, but no more objective skin signs. Suggestions have appeared in the popular press that various factors are the cause of VDU-related skin complaints, e.g. the electric and magnetic fields of the VDU, the electrostatic charge of the operator, deposition of air-borne

particles, x-ray emissions and ultraviolet radiation, but the documentation regarding these suggestions is rather scanty (9-11). In a provocation study (11) no relation was found between the symptoms of the patients and electrostatic or magnetic fields from the VDU. Ultraviolet and ionizing radiation are negligible (12).

Since the fall of 1985 the Swedish mass media has taken up the issue of the health effects of VDU exposure. The debate started after the National Insurance Board recognized one case as occupational damage. It was a 47-year-old woman with the dermatologic diagnoses of actinic elastosis and poikiloderma of Civatte (13). The diagnosis of actinic elastosis was based on histologic examination.

Lots of employees have been worried about skin damage resulting from VDU exposure. This was the reason why we carried out studies of individuals with VDU exposure both clinically (5) and epidemiologically (8). The aim of the present study was to investigate the possibility of any characteristic histological changes in patients with skin symptoms and/or signs being connected with VDU exposure by comparing them with persons with a similar clinical picture but without VDU exposure.

## MATERIAL AND METHODS

The study population consists of 134 subjects, divided into four groups; 1: patients with facial dermatoses claimed to be VDU-associated who were referred to the Department of Dermatology at the Karolinska Hospital, 2: patients without VDU exposure but with facial dermatoses, 3: referred patients with facial skin symptoms (e.g. itching, burning, stinging, pricking) claimed to be VDU-associated but without skin lesions, and 4: controls without skin problems or VDU exposure. All the patients with skin symptoms claiming to be VDU-associated had been working at VDUs for at least two years and for more than 20 hours a week. The groups of individuals without exposure were matched with the groups with VDU exposure as regards age and sex. Table I shows the distribution of individuals in the four groups. Most of the patients with skin lesions had rosacea or a rosacea-like dis-

Table I. The distribution as regards sex and age of the persons in the four study groups

Group	No.	Women/Men (%)	Mean age $\pm$ SD, range
Signs claimed to be VDU associated	66	88/12	46 $\pm$ 10, 24–63
Signs, no VDU work	28	64/36	46 $\pm$ 12, 20–59
Symptoms, claimed to be VDU associated, no signs	17	65/35	42 $\pm$ 9, 21–58
No symptoms/signs, no VDU work	23	43/57	42 $\pm$ 11, 28–67

case, but there were also a few patients with acne vulgaris. Punch biopsies (2 mm) were taken from skin laterally on the cheek. The patients without VDU exposure were recruited from ordinary dermatological out-patients, and the biopsies from them were collected after the other biopsies were taken. Our intention was that this group of patients should have signs of a comparable kind and degree to the signs of the VDU exposed patients (i.e. equal numbers of patients in the two compared groups with papules, pustules, erythema or telangiectases). The biopsies from the subjects in groups 3 and 4 were taken from skin without visible lesions. The controls without skin signs were recruited from colleagues and staff at the Department of Dermatology, friends and relatives. All biopsies except 10 from individuals in group 2 were taken by the same dermatologist (MB). Lidocaine 20 mg/ml with epinephrine 12.5  $\mu$ g/ml was used as the anaesthetic in all cases. Formalin-fixed, paraffin-embedded, 4  $\mu$ m thick specimens were stained with both hematoxylin-eosin and Unna polychrome-methylene blue (stains elastic fibers and the granules of mast cells (14)). About 10 non-serial sections were assessed for each subject.

Each sample was coded and assessed by three independent observers with regard to seven different parameters. These parameters and the scoring of them are shown in Table II. The type value obtained by the three observers for each parameter was used in the analysis, and the mean value was used in the few cases when three different values were obtained by the three observers. Agreement between the three observers was tested with Cohen's kappa-test (15). In this test the coefficient of agreement, kappa, is +1.0 with maximum agreement, and is negative when there is a poor agreement. For a comparison of the scoring of each parameter between the observers in pairs, the range of the kappa value was 0.15–0.62, mean value 0.42  $\pm$  0.12. The correlations differed significantly from random in all cases. A chi-square test for linear trends (16) was used to compare the scores between the groups. The comparisons were performed in pairs of groups; between the groups of patients with skin lesions and between the two groups of individuals without visible skin signs. Comparisons were also performed between the sexes and different categories of age. The term "statistical significance" refers to the 5 per cent level of significance, two-tailed.

Table II. The different parameters assessed, explanation of the scoring, and the staining and magnification used when scoring

Parameter	Staining	Magnif.	Scoring			
			0	1	2	3
Telangiectases	htx <sup>a</sup>	$\times$ 50	Absent	Moderate	Marked	
Intensity of inflammatory infiltrate	htx	$\times$ 50	Absent	Mild	Moderate	Marked
Hydropic degeneration of basal cells	htx	$\times$ 250	Absent	Moderate	Marked	
Occurrence of demodex folliculorum	htx	$\times$ 250	Absent	Yes		
Degenerative changes in elastic fibers	pmU <sup>b</sup>	$\times$ 250	Absent	Mild	Moderate	Marked
Mast cells	pmU	$\times$ 500	0–5/vf <sup>c</sup>	6–15/vf	> 15/vf	
Hyperplasia of sebaceous glands	htx	$\times$ 50	Normal	Moderate	Marked	

<sup>a</sup> hematoxylin-eosin, <sup>b</sup> polychrome-methylene blue (Unna), <sup>c</sup> view field.



Table III. Comparison between subjects with signs, with and without VDU exposure. The *p*-value refers to the trend, "NS" = not significant

Parameter	Score	Exposed		<i>p</i> <
		No (%)	Non-exposed No (%)	
Telangiectases	0	32 (48)	9 (32)	0.001 (non-exposed)
	1	27 (41)	4 (14)	
	2	7 (11)	15 (54)	
Inflammatory infiltrate	0	9 (14)	3 (11)	NS
	1	29 (44)	3 (11)	
	2	14 (21)	15 (54)	
	3	14 (21)	7 (25)	
Hydropic degeneration of basal cells	0	28 (42)	10 (36)	NS
	1	33 (50)	13 (46)	
	2	5 (8)	5 (18)	
Demodex folliculorum	0	60 (91)	25 (89)	NS
	1	6 (9)	3 (11)	
Degenerative changes in elastic fibers	0	16 (24)	9 (32)	NS
	1	26 (39)	6 (21)	
	2	20 (30)	10 (36)	
	3	4 (6)	3 (11)	
Mast cells	0	17 (26)	12 (43)	NS
	1	41 (62)	14 (50)	
	2	8 (12)	2 (7)	
Sebaceous glands	0	41 (62)	19 (68)	NS
	1	17 (26)	5 (18)	
	2	8 (12)	4 (14)	

Table IV. Comparison between subjects without signs, with and without VDU exposure. The *p*-value refers to the trend

Parameter	Score	Exposed		<i>p</i> <
		No (%)	Non-exposed No (%)	
Telangiectases	0	8 (47)	17 (74)	NS
	1	9 (53)	6 (26)	
	2	0	0	
Inflammatory infiltrate	0	1 (6)	5 (22)	NS
	1	12 (71)	14 (61)	
	2	4 (24)	4 (17)	
	3	0	0	
Hydropic degeneration of basal cells	0	14 (82)	13 (57)	NS
	1	3 (18)	10 (43)	
	2	0	0	
Demodex folliculorum	0	17 (100)	21 (91)	NS
	1	0	2 (9)	
Degenerative changes in elastic fibers	0	8 (47)	9 (39)	NS
	1	6 (35)	10 (43)	
	2	3 (18)	2 (9)	
	3	0 (0)	2 (9)	
Mast cells	0	3 (18)	11 (48)	NS
	1	13 (76)	10 (43)	
	2	1 (6)	2 (9)	
Sebaceous glands	0	5 (29)	8 (35)	NS
	1	7 (41)	10 (43)	
	2	5 (30)	5 (22)	

## RESULTS

The comparisons between the two groups with skin signs, and between those without signs, respectively, are shown in Tables III and IV. The only factor that was significantly more common in the comparison between exposed and non-exposed persons was the occurrence of telangiectases, which was significantly more common in patients with facial skin diseases without VDU exposure. No parameter was significantly more common in the VDU-exposed subjects. Four of the subjects with dermatoses claimed to be VDU-associated (three women aged 39, 45 and 48 years and one 25-year-old man) had non-typical symptoms, and claimed that they were sensitive to electricity. They all had the dermatologic diagnosis of rosacea. Two of these women had > 15 mast cells/view field. Hyperplasia of sebaceous glands was significantly more common in men ( $p < 0.001$ ) and decreased with increasing age ( $p < 0.001$ ). Degenerative changes in elastic fibers increased with age

( $p < 0.001$ ), but also occurred in persons below the age of 35 years ( $n = 30$ ; absent = 21, mild = 6 and moderate = 2), and on the contrary a few persons > 55 years of age ( $n = 29$ ) had absent ( $n = 4$ ) or mild ( $n = 11$ ) degenerative changes in elastic fibers. There was a significant correlation between the occurrence and degree of histologic changes for some parameters, e.g. telangiectases-mast cells, sebaceous glands-mast cells and degenerative changes in elastic fibers-telangiectases, while e.g. hydropic degeneration of basal cells and degree of inflammatory infiltrate did not show any significant correlation.

## DISCUSSION

The choice of the seven parameters to be compared was the result of our own previous experience from patients with skin symptoms claimed to be VDU related. Telangiectases are common in some diseases, e.g. rosacea (17) and are more common in sun-dam-



aged skin (18). The fact that telangiectases were significantly more common in the non-exposed group may be due to the multiple comparison problem, or may indicate that the compared lesions were not equivalent, despite our intentions. The anaesthesia with epinephrine used in the present study may influence the blood vessels, but we tried to standardize the procedure concerning concentrations and amount of anesthetics, and the site of the injection with regard to the biopsy site. Degenerative changes in elastic fibers increase with age (19, 20) and exposure to sun (21), and are also more common in some skin diseases, e.g. rosacea (17). It is difficult to prepare specimens for an objective counting of mast cells, and the standard fixation method used in this study is not specially designed to optimize the preservation of mast cells. However, the same procedure and staining (polychrome-methylene blue (Unna)) was used for all samples. The role of the mast cells in the skin is not fully understood, but they tend to aggregate around blood vessels, nerves and appendages (also shown with blood vessels and sebaceous glands in this study), and they are common in the facial skin (22). The mast cells release different mediators, e.g. histamine, leukotrienes and chemotactic factors (23). Histamine release plays a role in allergic diseases, e.g. in IgE mediated urticaria, but can also be a result of psychoneuro-endocrine influences, i.e. via a Pavlovian mechanism (24). There was a tendency (NS) for mast cells to be more common in the exposed groups, which may be of interest in this context. Release of inflammatory mediators such as e.g. histamine from mast cells may be the reason why the symptoms of the exposed patients were rather intense (itching, burning, sticking, pricking). There is a discrepancy between these intense symptoms and the rather mild or absent skin signs. Hyperplasia of sebaceous glands is part of some diseases (e.g. acne vulgaris), and is, as also shown above, more common in men and young adults.

No parameter was significantly more common in the VDU exposed patients. One major question then arises: is the study population large enough to allow for detection of histologic changes. It was calculated the number of subjects required was at least 15–20 in each group to detect a difference between two groups of about 40% with a method error of 10% (25). With at least 30 persons in each group (as for comparison between subjects with skin signs) it would be possible to detect a difference of about 30%. Thus, we think that the population is big enough to allow detection of

histological changes of an important nature. This view is supported by the differences seen when VDU exposed persons with skin lesions are compared with exposed persons without lesions (three parameters were significantly more common in those with lesions (hyperplasia of sebaceous glands, hydropic degeneration of basal cells and degree of degenerative changes in elastic fibers)), and when comparing the non-exposed groups with or without skin lesions to each other (two parameters were significantly more common in the group with skin lesions (occurrence of telangiectases and intensity of inflammatory infiltrate)).

As shown in Table IV control persons without skin problems also had histological changes of varying degrees. The occurrence of degenerative changes in elastic fibers was mainly dependent on the age of the subjects, but also occurred in persons below 35 years of age. Kligman has shown that hyperplasia in elastic fibers develops early in life and is found in all healthy subjects by the age of 40 to 49 (19).

Histopathological observation with scoring of variables in grade is not an exact method for detecting qualitative changes, because they depend to a large extent upon subjective assessments. However, in the present study a test for agreement between the observers was performed and it showed a rather good correlation with statistically significant correlation coefficients. This indicates a good reproducibility.

We have previously shown that VDU-exposed individuals do not have more objective skin signs than non-exposed persons (8). Patients with skin symptoms claimed to be VDU-associated had different degrees of rosacea in at least 50% of the cases, and most of the patients improved over time without pharmacological therapy in spite of continued VDU work (5). In a provocation study the 30 participating patients could not discriminate between VDUs with different magnitudes of electrostatic and magnetic field strengths (11). In the present study no specific histological skin changes were found by light microscopy in patients with skin problems claimed to be associated with VDUs.

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